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The Water bLog

a newsletter of the

Utah Center for Water Resources Research

at Utah State University

Welcome!

The Water bLog is the semi-annual newsletter of the Utah Center for Water Resources Research (UCWRR), housed at the Utah Water Research Laboratory. The center supports the development of applied research related to water resources problems in Utah and promotes instructional programs that will further the training of water resource scientists and engineers. Each issue of The Water bLog reports on a small selection of the current or recently completed research projects conducted at the center. More information is available online at:

http://uwrl.usu.edu/partnerships/ucwrr/

Message from the Director

Mac McKee, Director

This edition of the Water bLog features three on-going research projects that focus on water quality management and hydropower relicensing issues on some of Utah's rivers. These projects represent a small sample of the approximately 300 projects currently under way at the UCWRR. They are also good examples of applied research that has the potential to reduce water management costs in the state and to provide greater flexibility in the operation of rivers so that water demands can be more easily met. For example, the research currently being done on phosphorus management on the Little Bear River in Cache County is contributing to the state's ability to implement total maximum daily load plans, and is establishing the analytic capability to significantly reduce the cost of phosphorus removal from the river, perhaps by as much as tens of millions of dollars.

Those interested in more detail concerning these projects are encouraged to contact the researchers identified in each article. ■

INSIDE:

RESEARCH HIGHLIGHT

Phosphorus Management in the Little Bear River: Monitoring, Modeling, and Management

Recent research at the UCWRR is providing real-time data that is helping to improve management of the Bear River Basin Watershed. The large and growing data set will become part of the Bear River Watershed Information System

Among the many projects ongoing at the UCWRR are efforts to estimate and track phosphorus levels in the Bear River System in northern Utah. Elevated phosphorus levels in rivers and streams lead to decreased oxygen levels, toxic algae blooms, decreased biodiversity, and destruction of habitat and food supply for fish and other valuable native species. The ability to accurately track and estimate nutrient levels will assist

Jeff Horsburgh measures water quality in the South Fork of the Little Bear River

UtahStateUniversity

water managers as they make decisions to preserve the health of river systems.

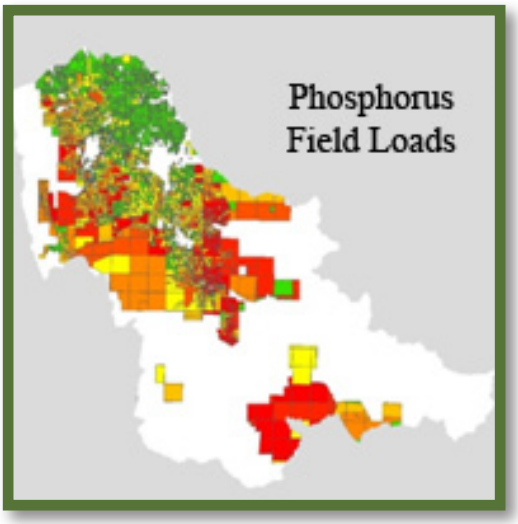
Research

Current projects include efforts to:

- Identify surrogate measures (e.g. turbidity) to estimate phosphorus in water systems, providing a less expensive method for obtaining high quality data.
- Develop a dynamic water quality model for portions of the Bear River System to track phosphorus loads under different management conditions.
- Upgrade and modify a dynamic water quality model to help track and evaluate total phosphorus (TP) loads and evaluate the potential for water quality trades both in cost effectiveness and TP load reduction.
- Establish monitoring stations in Cache Valley's Little Bear River watershed to assess the impact of location specific precipitation on overall precipitation and contaminant loading.
- Monitor five rivers draining into Cutler Reservoir and five locations within the reservoir itself to measure loading of nutrients and suspended sediments and general water quality in order to estimate the total phosphorus loading and corresponding oxygen demand under different environmental conditions.
- Connect the various Bear River System project data collection efforts into the Bear River Watershed Information System.

Amber Spackman moves algae away from water quality sensors in the Little Bear River

Data collection on the Little Bear River



"The ability to accurately track and estimate nutrient levels will assist water managers as they make decisions to preserve the health of river systems"

Benefits to the State

The Bear River Basin is critically lacking in hydrologic information systems for stream flow, water quality, and basic water and pollutant mass balances. These projects underway at the UCWRR will ultimately produce a large and growing data set for public and research use. Other benefits include the following:

- Provide long-term monitoring that will provide important flow and water quality observations that will be of interest to the Utah Division of Water Quality.
- Leverage existing monitoring infrastructure related to establishing a CUAHSI Hydrologic Observatory in the Great Salt Lake Basin, of which the Bear River Basin is a major part.
- Protect fisheries in the Cutler Reservoir based on phosphorus load trading in the Bear River Basin.
- Support State of Utah efforts to implement the total maximum daily load plan based on improvements to the City of Logan wastewater treatment plant to control phosphorus loads, and will help identify additional sources of phosphorus entering water systems.
- Provide real-time data for better management of the Bear River Basin Watershed -available on the Bear River Watershed Information System (http://bearriverinfo.org.) ■

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RESEARCH HIGHLIGHT

Temperature and Solute Model for the Virgin River

UCWRR researchers have developed a Two-Zone Temperature and Solute model that will provide water resource managers with information regarding the significant impacts that stream diversions, transient storage, changes in surface water-groundwater interactions, and drought may have on instream temperatures

Water shortages and drought result in low stream flows that are commonplace in Utah. In Washington County, drought and rapid population increases with associated water requirements can put a strain on an already limited water supply and lead to further reductions in flows.

Although water quantity is usually the focus of efforts to cope with low flows, the effects on instream temperatures are also important because of endangered species that are unique to the Virgin River (Virgin River Chub and woundfin). Under the Clean Water Act, states must establish water quality standards for temperature that meet the needs of sensitive species. States must also understand when and why these limiting conditions occur, and which management options will remedy the impairment.

"A (new) modeling framework... allows resource managers to run management scenarios to predict changes in the thermal regime within the main-stem Virgin River"

Ian Gowin records solar radiation measurements within the water column

The Virgin River Near Hurricane, Utah

Research

In this research, a Two-Zone Temperature and Solute (TZTS) model has been applied to the Virgin River for use as a management tool for the diverse stakeholders. These efforts include:

- Data collected that represents specific processes to ensure appropriate representation of heat sources and sinks in the model.
- Further research that determined data types required for better model population and calibration to increase confidence in management decisions.
- A modeling framework developed to incorporate various sources and characteristics of inflows, return flows, and water resource system infrastructure that allows resource managers to run management scenarios to predict the resulting changes in the thermal regime within the main-stem Virgin River.

Benefits to the State

This research will result in:

- Support for Virgin River Program water resource managers to evaluate alternative water resource allocation strategies that can ameliorate or eliminate the limiting factors associated with temperature.
- A modeling tool to improve water management strategies in the main-stem Virgin River that directly benefits municipal, industrial, agricultural, and environmental water needs.

Looking to the Future

The TZTS model is the basis for several ongoing research projects at the UCWRR. As new data collection and modeling methodologies have been proven successful and accurate in the Virgin River, they are continuing to be implemented in other river systems in Utah that have temperature impairments. Since the TZTS model was developed, and continues to be tested within a number of diverse rivers within Utah, the modeling capabilities will continue to be a useful decision-making tool within a large portion of the watersheds within the state. ■

Beth Neilson and Jon Bingham plot data collection results to guide next steps

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RESEARCH HIGHLIGHT

Defining Objectives for Meeting Mitigation Goals in Hydropower Relicensing

The UCWRR is evaluating realistic quantifiable objectives for instream flow restoration associated with hydropower operations. Monitoring Colorado cutthroat trout populations within Boulder Creek, Utah will help in assessing the impacts from both removal of non-native trout and restoration of bypass flows

Federal and state agencies often require various mitigation measures associated with aquatic ecosystems during licensing or re-licensing of hydropower projects. These mitigation measures can range from installation of stream improvement structures to increased bypass flows, but in many cases, little is known about the benefits of these measures on the downstream aquatic community. The success or failure of these measures is often tied to quantifiable objectives in terms of fish numbers per mile or biomass per acre; however, setting appropriate quantifiable objectives has been largely guess work with no clear, rational basis for expected outcomes.

"One cubic foot per second of water bypassed for environmental flows is equivalent to approximately $1,800,000 over the course of a 30-year license at current replacement power costs"

Research

The UCWRR is evaluating realistic quantifiable objectives for instream flow restoration associated with hydropower operations. Monitoring the population response of the Colorado cutthroat trout within the main stem and the east and west forks of Boulder Creek will help in assessing the impacts from both non-native trout removal and restoration of bypass flows below the East Fork Diversion structure. Objectives include:

- Monitoring fish and macroinvertebrate populations prior to and after chemical treatment to remove non-native trout.
- Examining the long-term response of trout population to increased flow rates.
- Examining the long-term response of native cutthroat trout to removal of non-native trout.

Colorado Cutthroat Trout

- Examining the linkage between aquatic food resources and trout population dynamics at different spatial and temporal scales.
- Developing a rational framework to establish quantifiable objectives during hydropower licensing or re-licensing forums to better determine minimum flow releases required.

Benefits to the State

Quantitative assessments of proposed mitigation actions associated with non-native fish removal and bypass flow releases will:

- Develop realistic monitoring metrics in aquatic systems in terms of invertebrate and fish communities necessary to define achievable quantifiable objectives.
- Provide a framework to guide hydropower operators to define achievable quantifiable objectives when dealing with federal resource agencies during hydropower facility licensing or re-licensing.
- Establish reasonable and rational monitoring programs based on quantifiable objectives.
- Establish a rational scientific basis for flow releases necessary for the protection and enhancement of Utah's aquatic resources.

Boulder Creek, Utah

Looking to the Future

One cubic foot per second of water bypassed for environmental flows is equivalent to approximately $60,000/year (or $1,800,000 over the course of a 30-year license) at current replacement power costs. Given the economic trade-off between power production and bypass flows for fish populations, quantifiable objectives will be useful in FERC relicensing proceedings. ■

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Upcoming

Nutrients and Water Quality: A Region 8 Collaborative Workshop

In partnership with the Colorado Water Institute, the Northern Plains and Mountains Regional Water Program, and the U.S. Environmental Protection Agency, the Utah Center for Water Resources Research and the Utah Water Research Laboratory at Utah State University are co-hosting a three-day workshop at the Hilton Hotel in Salt Lake City on February 15-17, 2011. Water management agencies and universities in the six states of EPA Region 8 (Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming) are invited to send representatives to the workshop to explore the science and institutional context regarding nutrients and water quality. The goal of the workshop is to build a better-informed and more tightly linked community of nutrient researchers, regulators, managers, policy makers, and stakeholders leading to collaborative approaches for developing and achieving nutrient controls. For more information, please visit the web page at:

http://www.cwi.colostate.edu/Workshops/Region8Nutrient/

February 15-17, 2011
Hilton Salt Lake City Center
Salt Lake City, Utah

Future Issues:

Research Highlights:

"Biological Processes for the Removal of Phosphorus from Lagoon Wastewater Facilities." (The UCWRR is researching various low-cost, biological processes to address the problem of excess phosphorus in municipal wastewater).

"Cooperative Study of Ambient Ammonia Distribution and Vertical Ozone Profiles." (Researchers at the UCWRR are developing protocols to economically and accurately characterize wintertime vertical O_3 profiles in Cache Valley, Utah).

Far Afield

In recent months, our visitors to the UCWRR have included the Ambassador from **Morocco**, the Minister of Higher Education from **Mali**, distinguished visitors from **Israel**, **Palestine**, **Egypt**, **Lebanon**, **Syria**, **Iraq**, **China**, and most recently a contingent from **Senegal**, **Guinea**, **Mauritania**, and **Mali**.

In addition, UCWRR Researchers have traveled to numerous countries in the past six months including:

- Cairo, Egypt
- Calgary, Canada
- Colombo, Sri Lanka
- Dakar, Senegal
- Erbile, Iraq
- Hanoi, Vietnam
- **Lima, Peru**
- Nanjing, China
- Seville, Spain
- Singapore, Singapore
- Tasmania, Australia
- Yangling, China

Rice and banana fields irrigated by water from the Poechos Reservoir, Peru

The UCWRR's legacy of involvement in international water research and development has recently taken our Director, Mac McKee, and one of his PhD students, Alfonso Torres, to Piura, Peru, to evaluate water and sediment management problems at the Poechos Dam, located in the Piura region in the northern part of Peru. ■

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